



CENTRE FOR EVIDENCE-BASED CONSERVATION

SYSTEMATIC REVIEW NO. 3: Effectiveness of current methods for the Control of Bracken (*Pteridium aquilinum*)

SUMMARY OF REPORT

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Stewart, G.B., Tyler, C. & Pullin, A.S. (2005). Effectiveness of current methods for the Control of Bracken (*Pteridium aquilinum*) Systematic Review No. 3. Collaboration for Environmental Evidence.

Summary

Background

Control of bracken (*Pteridium aquilinum*) is a global problem for livestock-based extensive agriculture, conservation, recreation, game management and forestry. Bracken is controlled primarily by application of asulam or by cutting. The success of bracken control may be dependent upon ecological variables (such as habitat type and latitude) and methodological variables (such as number and timing of treatments). We synthesised the available evidence regarding the effectiveness of bracken control interventions in order to identify knowledge-gaps and provide an evidence-base to support decision making where bracken control is a problem.

Objective

The primary objective was to assess evidence on the impact of asulam on bracken abundance and to determine why the impact might vary. A secondary objective was qualitative assessment of the impact of other bracken control interventions on bracken abundance.

Study Inclusion Criteria

Studies were included if they fulfilled the following relevance criteria;

- *Subjects(s)* studied – *Pteridium aquilinum* (except where it occurred in a woodland context).
- *Interventions* – Herbicides, Mowing or cutting, handpulling, rolling, use of livestock (cattle, sheep, ponies) or burning with control of bracken as an objective, and combination of techniques.
- *Outcome(s)* – Any change in the abundance of bracken including frond density, cover, frequency, above or below ground biomass.
- *Comparator* – appropriate controls (e.g. untreated reference areas) or pre-treatment comparators.
- *Type of study* – any primary studies.

Scope of the Search

Five databases (the bracken database, English Nature's "Wildlink", Index to Theses Online, ISI Web of Knowledge and JSTOR) were searched for published and unpublished information using a range of search terms. Bibliographies of retrieved articles were checked for additional relevant references. Subject experts were contacted.

Main results

Over 2995 references were retrieved. These provided 46 relevant data points for meta-analysis of asulam impact, with a further 14 references pertaining to bracken control by other means. Meta-analysis confirmed that asulam application significantly reduces the abundance of bracken. Meta-regression confirmed that the number of applications of asulam has a significant impact on effectiveness, with multiple follow

up treatments necessary for good control. Other variables such as habitat, latitude, timing of application, and concentration of herbicide did not have a significant impact on asulam effectiveness. There was insufficient information regarding other interventions for robust meta-analysis. Qualitative synthesis suggested that cutting could be as effective as asulam application.

Conclusions

Implications for Management

Available evidence suggests that asulam application reduces the abundance of bracken although subsequent regeneration can be rapid. Multiple applications of asulam are more effective than single applications, slowing the speed of recovery. More high quality research and monitoring is required to ensure that current management recommendations are generic rather than site specific, but there is no evidence that they require modification. However, much current control consists of a single application of asulam with no or limited follow up. This is ten times less effective than control with multiple follow up. It is therefore more effective to spray a fifth of a site five times over five years than the whole site once. The former treatment results in decreased bracken abundance across a fifth of the site, whilst the latter treatment may have no effect at all by the fifth year. Qualitative evidence suggests that cutting could be as effective as asulam application, particularly if two cuts are applied within the same growing season, but further work is required for corroboration.

Implications for further research.

Further research is required to fill a number of knowledge gaps regarding the impact of bracken control strategies. There is a lack of head to head comparisons regarding the effectiveness of different control strategies. In particular, long term work comparing cutting and asulam application is required to build on the existing work. There is no robust experimental evidence regarding the impact of rolling on bracken abundance, although the technique is being applied at a small scale on inaccessible ground unsuitable for cutting machinery. Ongoing monitoring of rolling impacts and experimentation on bracken bruising should receive funding to ensure its continuity.

With respect to asulam application, further information is needed on the number of follow up treatments and aftercare required for specified levels of desired control. Complete eradication of bracken using asulam has not yet been demonstrated experimentally, although one study (Spaunton Moor, UK) provides evidence that virtual eradication is possible. Further work is also required regarding the efficacy of different application techniques, as this work suggests that their effectiveness is variable. The impact of many effect modifiers such as habitat, location and land management also require further investigation across multiple sites if generic bracken control strategies are to be validated. Further meta-analysis is ongoing but this should be augmented with the collection of additional data to increase sample sizes and minimise confounding effects.

Future experimental work should give careful consideration to abundance measures. Although, easily measured, frond density is not a good measure of

bracken abundance as it fluctuates rapidly. Rhizome abundance is considered the optimal measure, preferably measured alongside frond biomass.

Further primary studies are an essential component of the required research but further synthesis of large scale information e.g. correlating countryside survey vegetation change data with areas where bracken control has been funded through agri-environment schemes; and monitoring the effectiveness of bracken control where aerial spraying has occurred, could also be valuable tools.

However, some researchers believe that further research on control would necessarily detract from research on other topics; namely the steps needed to regenerate appropriate vegetation after control and also what is causing bracken to spread in the first place. These topics are beyond the scope of the existing review but important questions worthy of further attention.